基于UWB信号的单点血管弹性评估

RF-AE: Single-site Arterial Elasticity Estimation Using UWB Signals

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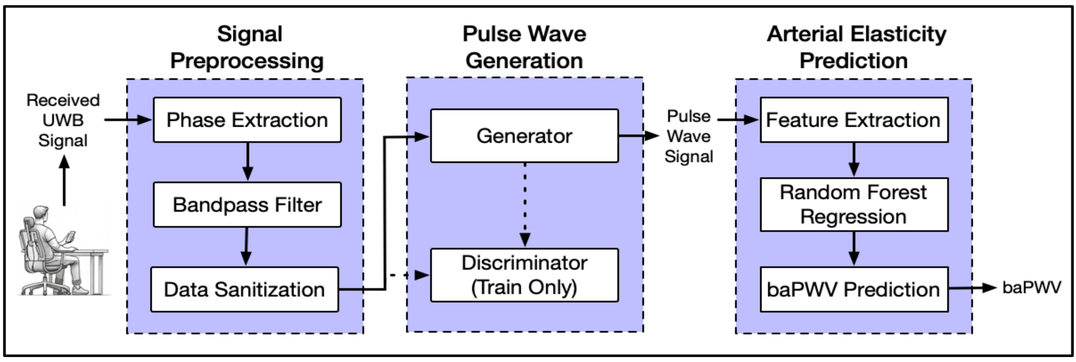
Motivation

- Arterial elasticity is a key indicator of cardiovascular health, with high elasticity representing healthy arteries and decreased elasticity leading to increased cardiovascular risk.
- Conventional methods need to be performed by professionals in clinical settings and are often costly, making them impractical for regular monitoring.
- To provide regular monitoring and early warning for individuals with arterial elasticity-related diseases, we focus on estimating arterial elasticity contactlessly.

System Architecture



- Signal preprocessing: This module comprises phase extraction, bandpass filtering, and data sanitization.
- Pulse wave generation: To accurately extract features related to arterial elasticity directly from the phases of UWB signal, we propose a two-step strategy, i.e., first design a deep generative model to generate the pulse wave from phases of UWB signal, and then extract features from the generated pulse wave.
- Arterial elasticity prediction: We extract several critical features and employ the random forest regression to predict brachial-ankle pulse transit time using the extracted features as input. Then, combined with a body-height based method for estimating the length of the pulse transit path, we obtain brachial-ankle pulse wave velocity, a key indicator for assessing arterial.

Evaluation & Results

- Compared to the ground truth of brachial pulse waves, the median cosine similarity is 0.94 and the median Pearson correlation coefficient is 0.95.
- We conduct extensive experiments, and the experimental results show that RF-AE can accurately assess the arterial elasticity of users with a median percentage error of 5.47%.